# RESEARCH ON SOLUTIONS TO DETECT DISEASES ON ROSE LEAVES USING IMAGE PROCESSING TECHNIQUES

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**ABSTRACT**

Nowadays, Image processing techniques are widely applied in agricultural production, especially on agricultural products. In this paper, we propose a solution to detect diseases on rose leaves by an image processing algorithm based on leaf features. This algorithm helps detect diseases on rose leaves through collected images. The method is solved through stages such as: collecting images, formatting the size of images, separating the leaf image area from the background and then detecting and zoning the candidate areas that are likely to be diseases by the SimpleBlobDetector algorithm. Experiments on a dataset of 500 images showed that the model had an accuracy of 93.30%. This is a new method for automatic disease detection on rose leaves. The source images and collected images were taken by us and processed by our algorithm. The results show that the proposed method is able to apply for real applications in the future.

# NGHIÊN CỨU GIẢI PHÁP PHÁT HIỆN BỆNH TRÊN LÁ HOA HỒNG BẰNG KỸ THUẬT XỬ LÝ ẢNH

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**TỪ KHÓA**

Thuật toán xử lý ảnh
Đặc trưng hình ảnh
Xử lý ảnh
Thuật toán SimpleBlobDetector
Phát hiện bệnh trên cây trồng

**TÓM TẮT**

Ngày nay, kỹ thuật xử lý ảnh được vận dụng nhiều trong sản xuất nông nghiệp, đặc biệt là trên nông sản. Trong nghiên cứu này đề xuất giải pháp phát hiện bệnh trên lá hoa hồng bằng một giải thuật xử lý ảnh dựa trên đặc trưng của lá. Thuật toán này giúp phát hiện những vết bệnh trên lá của cây hoa hồng qua hình ảnh được thu thập từ vườn cây trồng. Phương pháp thực hiện theo các bước sau: thu thập ảnh mẫu, định dạng kích thước ảnh mẫu, tách vùng ảnh lá ra khỏi nền và sau đó chạy thuật toán SimpleBlobDector để phát hiện, khoanh vùng những ứng viên có khả năng là đốm bệnh. Thực nghiệm trên tập dữ liệu thu thập từ 500 hình ảnh cho thấy mô hình đạt độ chính xác 93,30%. Nghiên cứu này nhằm đưa ra một hướng đi mới trong việc phát hiện bệnh trên lá hoa hồng một cách tự động. Các ảnh nguồn và ảnh thu thập đã được chúng tôi thực hiện kiểm chứng với phương pháp đưa ra. Kết quả thu được chứng tỏ tính khả thi của phương pháp đề xuất.

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## 1. Introduction

In recent years, along with graphics technology, image processing plays a very important role in human-machine interaction systems. In which, object recognition is a common problem in the field of image processing. Object recognition can be applied in many different fields such as agriculture, banking, military, etc. through detecting, identifying, tracking, or searching for real objects.

In the field of agricultural production, disease detection on crops plays an important role. Currently, the method to detect plant diseases is to observe with the eyes. However, this method requires farmers to spend a lot of time and monitor the production area continuously, which requires very high costs when implemented with large farms. To detect disease at an early stage, it is very beneficial to use automated disease detection techniques. Automatic disease detection just by seeing symptoms on leaf features [1] – [4]. Some of the common diseases in crops are brown and yellow spot, early and late scorch, and others are fungal, viral and bacterial diseases. Image processing is used to identify the affected area of the disease based on the difference in color of the affected area [5], [6].

Sa Dec flower village in Dong Thap province (Tan Quy Dong ward) is a craft village formed hundreds of years ago and is the largest supplier of ornamental flowers in the Mekong Delta. Sa Dec flowers and ornamental plants are supplied to the Mekong Delta provinces, Ho Chi Minh City, central provinces, Cambodia market and are heading to other large export markets. In the process of planting and taking care of ornamental plants, whether planted in pots or planted in the ground, the possibility of plants contracting diseases and suffering very heavy damage from the biting of insects.

Using the development of image processing techniques and computer vision to help farmers detect pests on leaves [7] – [9]. In this article, we apply the SimpleBlobDetector algorithm in image processing to detect insect-infested leaves of some ornamental plants in Sa Dec ornamental garden. Through some features of color and shape extracted from the image of leaves to detect the insect-infested leaves of ornamental plants.

## 2. Methods/Materials

The method used in this paper is the SimpleBlobDetector algorithm that the OpenCV library supports. First, the digital image of the leaves is acquired by the camera. Then the image is processed. The process of detecting disease signs is based on the characteristics of color and shape on leaves. Image preprocessing is applied to isolate the background color of the image, and then convert the leaf image from BGR to gray using the cv2.cvtColor function supported in OpenCV to highlight strange features that show signs of disease on the leaves.

### *2.1. Describe algorithm*

The steps below illustrate the procedures for detecting diseases on rose leaves using the proposed algorithm:

(1) Image acquisition is the first step with the help of a digital camera.

(2) Preprocess the input image to improve the image quality and remove unwanted distortion from the image. Leaf image clipping is done to get the image area of interest and then image smoothing is done using Gaussian method to calculate the transformations applied to each pixel in the image. Gaussian smoothing is also used as a preprocessing stage to enhance the image structure at different scales. The parameters in the algorithm are all hard-assigned, so the size of the input image is adjusted relatively the same. The formula of Gaussian function in one dimension is as below formula (1):

$$G(x) = 1 / sqrt(2\pi\sigma^2) * e^{-(x^2 / 2\sigma^2)} \quad (1)$$

(3) Most images have a background color. In this step the background of the image will be removed. In this section, we proceed to convert the background image to gray to highlight the strange features on the leaves.

(4) Detecting special points: Special points on the image will be searched using SimpleBlobDetector algorithms through setting numbers such as coordinates, size, brightness, and shape.

Depending on the specific settings of the SimpleBlobDetector algorithm, parameters such as the size, shape of the objects to be searched, and the minimum brightness of the points that are considered objects can be adjusted to optimize the efficiency of the algorithm.

The configuration parameters of the SimpleBlobDetector algorithm include: (1) Threshold, (2) Area, (3) Circularity, (4) Convexity, (5) Inertia ratio. Here are the parameters you can set for blob detection using SimpleBlobDetector Table 1.

**Table 1.** *Configuration parameters of SimpleBlobDetector*

| **Threshold** | | **Area** | | **Circularity** | | **Convexity** | | **Inertia** | |
|---|---|---|---|---|---|---|---|---|---|
| max | min | max | min | max | min | max | min | max | min |
| 1000 | 10 | x | 300 | x | 0.1 | x | 0.87 | x | 0.01 |

(1) Threshold: Convert the source image to some binary image by thresholding the source image with thresholds starting from minThreshold value. These thresholds are increased by thresholdStep up to the maxThreshold value. So, first threshold is minThreshold, second threshold is calculated as minThreshold + thresholdStep, third threshold is minThreshold + 2 x thresholdStep and continue to calculate for next thresholds.

(2) Area: The minimum area size that an object must have to be considered a valid feature.

(3) Circularity: The roundness of an object, calculated as the ratio between the object's circumference and its area. To filter by circle, set filterByCircularity = 1. Then set the appropriate values for minCircularity and maxCircularity.

The circularity index is calculated as the ratio of the area of the object to the area of a circle whose radius is equal to the average length of the object formula (2):

$$Circularity = (4 * pi * Area) / (Perimeter^2) \qquad (2)$$

In there:

- Area is the area of the object.
- Perimeter is the circumference of the object.
- pi is a constant ( pi = 3.14159...).

The circularity value is between 0 and 1. If the object is a perfect circle, the value of circularity is 1. If the object is not a circle, the circularity will be less than 1.

(4) Convexity: The object's convexity, calculated as the ratio between the object's area and the area of its convexity. In image processing, convexity is often used to analyze the shape of an object and classify objects based on their shape.

Convexity is calculated as the ratio between the area of the object and the area of the object's convex hull formula (3):

$$Convexity = Area / ConvexArea \qquad (3)$$

In there:

- Area is the area of the object.
- ConvexArea is the area of the convex polygon of the object.

The value of convexity ranges from 0 to 1. To filter by convexity, set filterByConvexity = 1, followed by setting $0 \leq$ minConvexity $\leq 1$ and maxConvexity $\leq 1$.

(5) Inertia ratio: (delay ratio) is an indicator that quantifies the delay of the subject in the image. In image processing, delay is often used to analyze the shape of an object and classify objects based on their shape.

Delay is calculated as the ratio between the maximum and minimum value of the object's delay formula (4):

$$InertiaRatio = Imin / Imax \quad (4)$$

In there:

- Imin is the minimum value of the object's delay.
- Imax is the maximum value of the object's delay.

The value of the delay ratio is between 0 and 1, set filterByInertia = 1, set $0 \leq$ minInertiaRatio $\leq 1$ and maxInertiaRatio $\leq 1$.

### *2.2. Algorithm setup*

Input: the image is converted to gray (parameter gray)

Output: images are identified disease areas

Procedure: To determine the candidate areas for leaf disease using the SimpleBlobDetector algorithm, this algorithm is carried out through stages as shown in Figure 1.

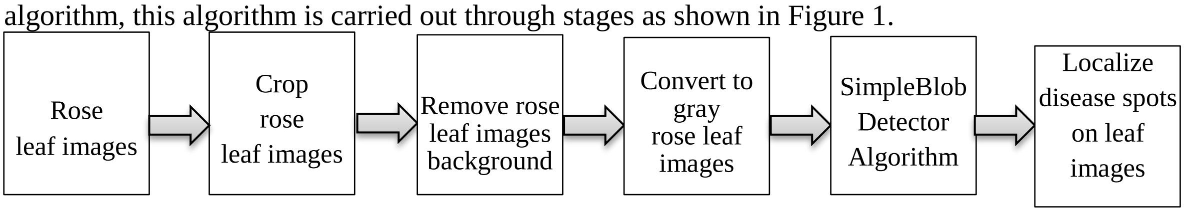


**Figure 1.** *Steps to implement the SimpleBlobDetector algorithm*

### *2.3. Compare algorithms*

#### *2.3.1. K-mean algorithm*

K-Means algorithm classifies the input data points into many number of classes based on clusters inherent distances. The algorithm assigns that data features to create a vector space for clustering. These data points are clustered around centroids. To detect objects in an image using the k-means algorithm by follow these steps:

- Preprocess the image: Convert the image to grayscale if it is in color. Grayscale images simplify the clustering process by reducing the number of dimensions.
- Prepare the data: Convert the image pixels into a feature vector that can be used for input value to the k-means algorithm.
- Choose the number of clusters (K): Determining the number of clusters in algorithm that can determine the number of objects want to detect.
- Initialize the centroids: initialize K centroids at random. These centroids represent the initial cluster centers
- Assign data points to clusters: Calculate the distance between each data point and the centroids. Then, assign each data point to the nearest centroid.
- Update the centroids: reupdate the centroids by taking the mean of all the data points assigned to each cluster.
- Repeat steps 5 and 6 until convergence: Iterate steps 5 and 6 until the centroids no longer change significantly or a maximum number of iterations is reached.
- Visualize the results: Plot the clusters with different colors to clarify detected objects in the image.

#### *2.3.2. Image segmentation and soft computing techniques*

There are several techniques that can be used for image segmentation, including edge-based segmentation, region-based segmentation, clustering, thresholding, and soft computing-based segmentation.

Here are the steps involved in performing image segmentation using soft computing techniques:

- Preprocess the image: The images can be collected by digital camera. Input images will be processed to improve the quality of the images. This can involve techniques such as noise reduction, contrast enhancement, and image resizing.

- Thresholding techniques: most green colored pixels are masked. In this step, a threshold value for these pixels computed. If the pre-computed threshold value is more than pixel intensity of the green com-ponent, then the red, green and blue components of this pixel is assigned zero value.

- Removing the masked cells: this step identifies the infected clusters. Then, the masked cells in these clusters are removed.

- Clustering: do clustering appropriately to classify the leaf diseases. Genetic algorithms (GAs) can be used to optimize image segmentation by searching for the set of parameters. Then, using the color co-occurrence method computes the features of an image. In this method, both the texture and color of an image are considered.

- Disease classification: in this step, proceed to extract and compare the co-occurrence feature for the leaves with values stored in the feature dataset. Image is classified by using Support Vector Machine methods.

## 3. Results and Discussion

All experiments were performed on COLAB using Python language. For the input data are leaf samples such as roses with bacterial diseases. Figure 2 shows the original images followed by the background subtracted and grayed out images. Figure 3 shows the input and output images where the input image is a rose diseased by bacteria and the output image detects diseased areas by feature extraction.

The leaf anomalies also appear when the input image is processed and converted to color space. The features appearing on the leaves are extracted using the SimpleBlobDetector algorithm through parameters such as coordinates, size, brightness and shape and its efficiency with an accuracy of 93.3%.

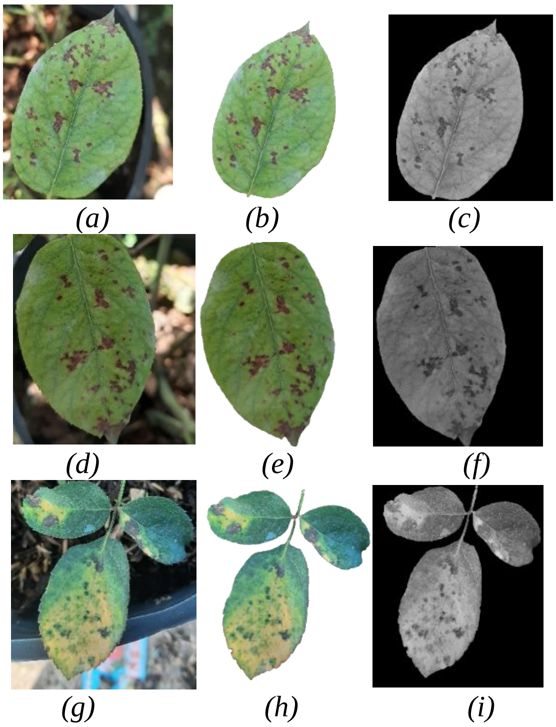

**Figure 2.** *Input image and output:(a),(d),(g) input image;(b),(e),(h) image after removing background color and (c), (f), (i) converting to gray space.*

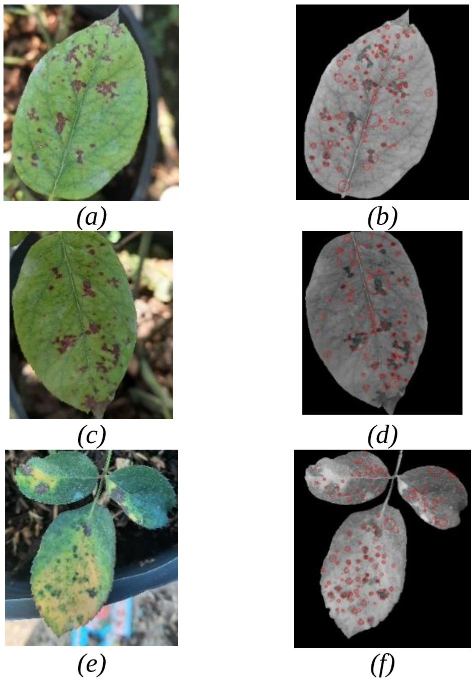


**Figure 3.** *(a), (c), (e) Input image and (b), (d), (f) image after identifying disease spots*

Currently, image processing is widely applied in the field of agricultural production. Among them, there are many studies on the techniques of detecting diseases on leaves. Each technique has its own strengths and is widely used in production.

In which, the detection of disease signs on rose leaves using the Minimum Distance Criteria technique with K-Mean Clustering gives an accuracy of 81.54%, the accuracy when using image segmentation and soft computing techniques is 91% [4], [10]. The comparative data is shown in Table 2 and Figure 4.

**Table 2**. *Comparison of results*

| Disease samples | No. of images used for testing | Detection accuracy (%) | | |
|---|---|---|---|---|
| | | K mean | Image segmentation and soft computing techniques | SimpleBlobDetector |
| Rose leaf | 12 | 81.33% | 91.66% | 93.3% |

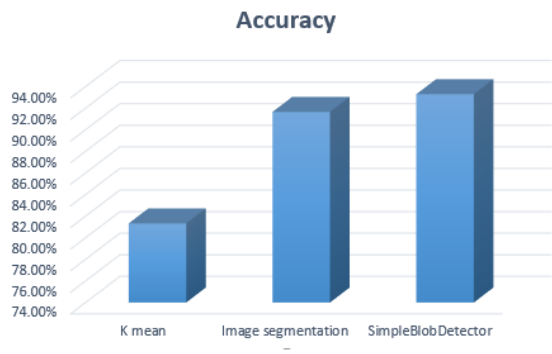


**Figure 4**. *Comparison of results*

During the implementation of the algorithm application, many parameters in the algorithm are still hard-wired, the input images must be processed to have the same size, so the problem-solving algorithm is still rigid. identification of the disease area is limited. It is possible to use a combination of SimpleBlobDetector algorithm and neural network method for flexible operation and higher accuracy [1], [8], [9].

To compare SimpleBlobDetector with other methods, it is important to note that the best method often depends on the specific task and available data. Image segmentation and k-means algorithms can also be used for blob detection, but they may be more suitable for images with specific features.

For the Image segmentation algorithm that works by partitioning the image into distinct regions or objects containing groups of pixels with similar properties such as intensity or color [7], [11], this method accepts inaccuracies. accuracy, approximation and uncertainty, making them highly preferred for tasks like image segmentation and making it a good choice for some medical imaging applications. Although Image segmentation algorithm has shown promising results in image segmentation for disease detection. The result of image segmentation can be affected by a number of factors, such as the similarity of the objects contained in the image, the characteristics of the image texture and the content of the image. Therefore, the choice of Image segmentation method is highly dependent on the specific image type and the specific requirements of the task.

As for the K-means algorithm is a good choice when knowing the number of blobs, as this algorithm can separate them based on their pixel intensity. The K-means method is often used to partition the data set into a set number of clusters (k) based on the similarity between the data points. K-means works by assigning each data point to the cluster with the closest mean. As a result, it is scalable and highly performant, especially with large datasets, and the algorithm is relatively easy to implement and understand. However, K-means has difficulty in determining k, the number of clusters k needs to be determined before running the algorithm. Determining the optimal number of clusters can be challenging, and different values of k can lead to different results.

It can be seen that the SimpleBlobDetector algorithm is advantageous for a number of reasons. First, it's simple and easy to use with adjustable parameters that allow customization based on specific needs. Next, it is also relatively efficient and can deal with blobs of different shapes and sizes thanks to different filtering methods. However, SimpleBlobDetector also has some limitations. It doesn't work well with blobs of different intensities or colors, and it can have problems with overlapping blobs [12].

In conclusion, although the SimpleBlobDetector algorithm is a powerful tool for blob detection, it is important to understand its strengths and limitations and to consider other methods based on specific requirements that may depend on the identity of the object..

## 4. Conclusion

This study presents the results of the implementation of SimpleBlobDetector technique of OpenCV library to detect diseases on rose leaves and the algorithm can be developed into an automatic disease detection and classification application on leaves later. The results obtained from this study show the effectiveness of the proposed algorithm in detecting foliar diseases when it detects new signs of changes forming on the surface of rose leaves. The parameters of SimpleBlobDetector can be easily tailored to specific needs so that different blob shapes and sizes can be accurately recognized. This also shows the outstanding advantage of the proposed algorithm that it can identify and classify other leaf diseases more efficiently and save time.

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